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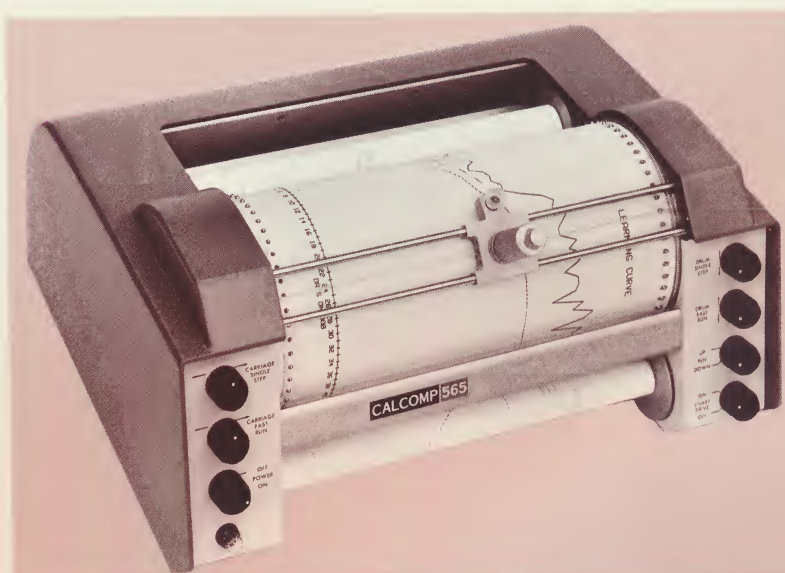
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DIGITAL
PLOTING
SYSTEMS

CONTENTS

COMPUTER CONTROLLED DIGITAL PLOTTING	1
PRINCIPLES OF OPERATION	2
DIGITAL PLOTTING APPLICATIONS	4
DIGITAL PLOTTERS	6
MAGNETIC TAPE SYSTEMS	8
ELECTRONIC PLOTTER	10
TRACER/DIGITIZER	11
PLOTTER CONTROLLERS	12
REMOTE PLOTTING SYSTEMS	13
HOW DO YOU EVALUATE A DIGITAL PLOTTING SYSTEM?	14
SUPPORTING SERVICES	16
DIGITAL PLOTTING ACCESSORIES	16



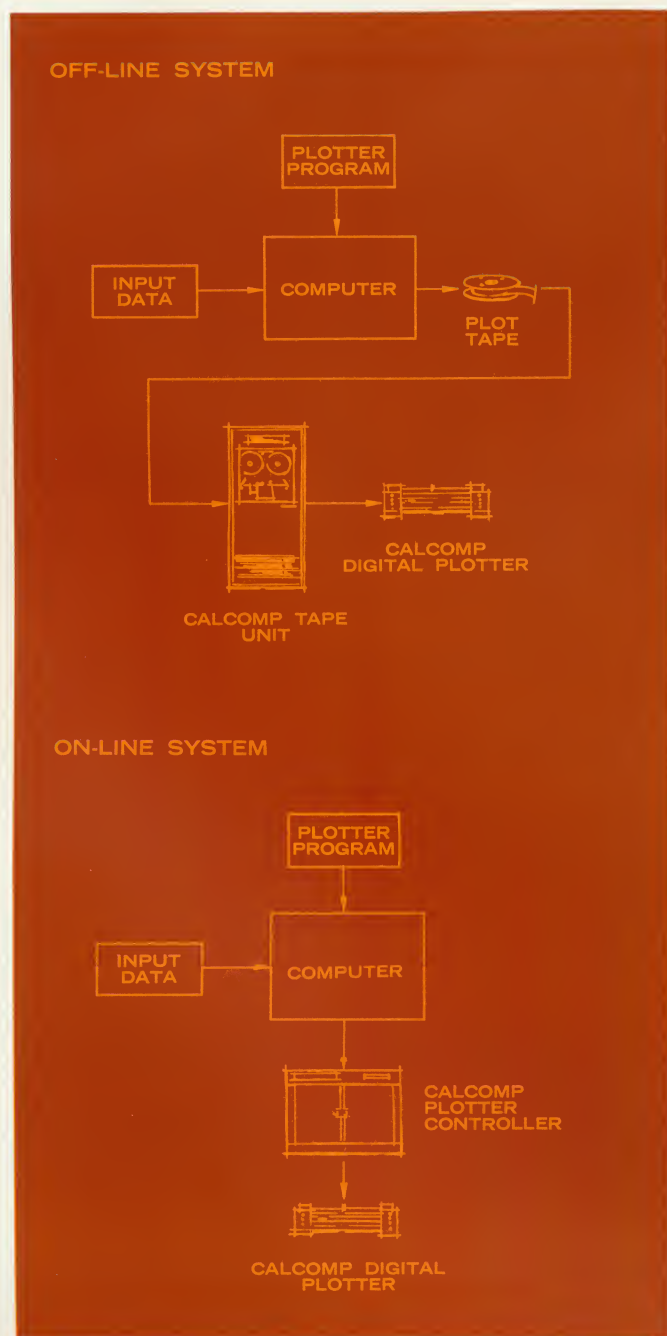
The function of a digital plotting system is to present digital computer output in pictorial or graphic form. CalComp offers a variety of equipment to perform this function. This bulletin summarizes the digital incremental plotting principle, presents pertinent points of consideration in evaluation of plotting systems, and provides comparative specifications on the equipments available from CalComp.

COMPUTER CONTROLLED DIGITAL PLOTTING

Digital computers are used in many industries, businesses, and government agencies to solve problems and generate data. They are indispensable where the volume of computations and quantity of data makes manual operations either uneconomical or impossible.

Automatic plotting devices are used in conjunction with digital computers where graphic or pictorial presentations of computer data are meaningful and easier to use than extensive alphabetic or numeric listings. They too are indispensable when the volume of graphic presentations makes it uneconomical or impossible to perform the task manually.

CalComp digital plotting systems provide an efficient, flexible means of producing high quality ink-on-paper or microfilm plots of computer output data, with unvarying accuracy. There is no restriction on format, so that a pictorial representation may include any desired combination of axes, lines, letters, and symbols, with unlimited choice of scale factors, letter and symbol sizes, and printing angles.



PRINCIPLES OF OPERATION

All CalComp digital plotters operate on the basic *digital incremental* principle. Decoded input commands from the computer are used to produce incremental steps in either direction along either axis, or at some angle relative to the axes. In the electromechanical plotters, the plot is produced by movement of a pen relative to the surface of the recording paper. In the electronic plotters, the plot is produced by movement of a cathode ray tube electron beam, and the plot is recorded automatically on microfilm. Decoded computer commands are used to raise and lower the pen, or to blank and unblank the electron beam.

Because CalComp electromechanical plotters operate in completely digital fashion, they are drift-free. Accuracy is not dependent on voltage stability as it is in systems which employ digital-to-analog conversion for positioning of a servomechanism. Since operation is fully incremental, there is no restriction on format. The user has complete freedom of choice in size, type, and orientation of letters, symbols, lines and axes. In short, any type of computer output data capable of presentation in graphic form can be reproduced automatically on a CalComp digital plotter. And all CalComp plotters are suitable for either on-line or off-line operation with any standard computer.

INK-ON-PAPER PLOTTERS

The CalComp product line includes three model series of electromechanical ink-on-paper digital plotters. Specially designed bidirectional step motors and precision gearing are used to produce discrete steps in the desired direction.

In the CalComp 500 series plotters, each input command produces one incremental step of the pen relative to the paper. Each step may be in any one of eight directions, as shown in the diagram (opposite). The incremental step



size is determined by the gearing in the plotter and several options are offered for each model. (Incremental step sizes range from .002 to .010 inch.) Maximum incremental speeds vary from 200 to 450 steps per second, depending on the model and step size. Both drum and flatbed models are available.

The CalComp 700 series digital plotters operate at higher incremental speeds—up to 450 steps per second—and include a number of special features. In addition to the incremental mode, the 700 series incorporates the exclusive Zip Mode® for very high speed plotting of straight lines or smooth curves, with a significant reduction in computer time required to generate the plot commands. In this mode, the input commands function as velocity increments rather than incremental step commands. The Zip Mode permits operation of the plotter at speeds up to nearly four times the maximum speed in incremental mode. An additional feature of the 700 series plotters is the “electronic gear shift,” another CalComp exclusive. Each step motor may be commanded to move either a full incremental step, or a half step, depending on the input command code. By appropriate combinations of full-step and half-step commands in the X and Y axes, incremental vectors of 24 different combinations of length and direction can be produced. (See diagram). This feature provides a considerable increase in plotting resolution compared to the full-step incremental method. The 700 series plotters also offer a choice of several incremental step sizes, in both drum and flatbed models.

The CalComp 600 series incorporates certain features of both the 500 and 700 series, and is program-compatible with both. The 600 series plotters operate at incremental rates up to 900 steps per second, depending on the model, and several step-size options are available. With 500-series input format, each input command produces a plotter step in one of eight

basic directions. Full-step or half-step increments are manually selectable. With 700-series input format, the “electronic gear shift” feature of programmable full-step, half-step, or full-step/half-step intermix is available for improved resolution, with 24 basic steps. Two drum type models are available.

ELECTRONIC PLOTTER

The CalComp Model 835 Electronic Digital Plotter operates on the same basic incremental principle as the ink-on-paper plotters. The plot is generated electronically on the screen of a cathode ray tube and automatically recorded on microfilm. This makes it possible to plot at much higher speeds (up to 100,000 increments per second).

OFF-LINE SYSTEMS

For off-line digital plotting, CalComp magnetic tape systems provide the special features and high reliability required for low-speed reading of standard format tape to operate the digital plotters. Off-line operation provides the most efficient use of computer time, without expensive buffering, and with fewer record gaps.

ON-LINE SYSTEMS

CalComp offers a wide selection of interface units for on-line digital plotting with most standard computers, including the new time-shared systems. The new series of CalComp Plotter Controllers incorporates a number of operator convenience features, optional core buffers, and compatibility with the full product line of digital plotters.

REMOTE SYSTEMS

CalComp also offers a selection of interface units for remote digital plotting with any 500 series plotter. These units are compatible with Bell System DATA-PHONE electronics, in either off-line or on-line system configurations.

DIGITAL PLOTTING APPLICATIONS

The applications for CalComp digital plotting systems are as numerous and varied as the applications for the computers they complement. In every branch of government, in every scientific field, in industry and business, CalComp digital plotters and plotting systems have proved their accuracy, reliability, and efficiency. *Any* computer output data that can be reduced to graphic form manually can be automatically plotted on CalComp equipment—faster, with greater precision, and usually at lower cost. Listed below and illustrated on the opposite page are just a few of the present applications for CalComp digital plotting systems. There are hundreds more—both present and future.

SCIENCE

- Atomic structure analysis
- Medical and psychiatric diagnosis
- Nuclear explosion seismograms
- Weather data mapping
- Radio telescope studies
- Satellite flight tracking

INDUSTRY

- Automatic drafting
- CPM and PERT scheduling
- Verification of machine tool control tapes
- Ship pattern design

ENGINEERING

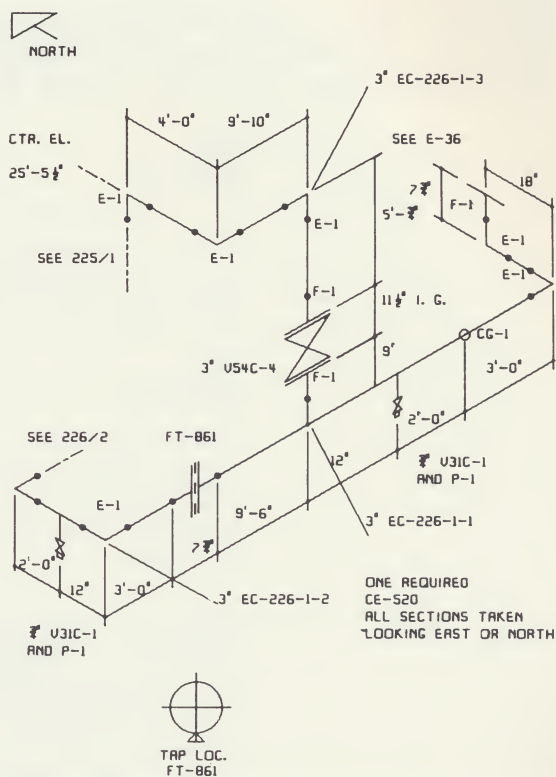
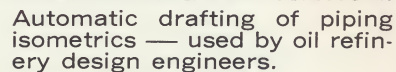
- Air traffic recording
- Highway cross sections
- Traffic pattern analysis
- Oil survey measurements
- Test data graphs
- Contour mapping

BUSINESS

- Financial analysis
- Inventory and budget control
- Advertising and market research
- Profit and loss trends

FOR DETAILED INFORMATION ON YOUR APPLICATIONS CONTACT
"CALCOMP MARKETING" OR YOUR LOCAL SALES REPRESENTATIVE

Learning curves showing employee performance relative to cumulative averages—used in establishing piece-work rates.



DIGITAL PLOTTERS

CalComp offers a complete line of digital plotters—a total of ten basic models for computer controlled preparation of quality ink-on-paper graphic presentations. All are suitable for either off-line or on-line operation.

500 SERIES

The CalComp 500 series includes two drum and two flatbed types, each available in a choice of incremental step sizes. Maximum incremental step rates are from 200 to 450 steps-per-second, depending upon the model. Each step, under program control, may be in any one of 8 directions.

600 SERIES

The CalComp 600 series includes two drum types, with optional incremental step sizes. These units are program-compatible with both the 500 and 700 series plotters. The 600 series plotters operate in either full-step or half-step mode, at incremental rates up to 900 steps-per-second in the half-step mode.

700 SERIES

The CalComp 700 series includes two drum and two flatbed types, with optional step sizes. The 700 series plotters operate at incremental step rates up to 450 steps-per-second, and include the exclusive Zip Mode® for driving the plotter at several times the maximum incremental speed. Another feature is the “electronic gear-shift” which permits either full-step or half-step operation, or a combination of the two, for improved resolution. This capability results in 24 basic plot steps.

DRUM TYPE

CalComp drum type plotters are available in two sizes: a 12-inch drum and a 30-inch drum. The plot is produced by rotary motion of the drum (X-axis) and lateral motion of the pen carriage (Y-axis). Either ballpoint or liquid ink pens may be used. The drum type plotter uses special chart paper rolls and can produce continuous plots up to 120 feet in length. A wide selection of paper is available.

FLATBED TYPE

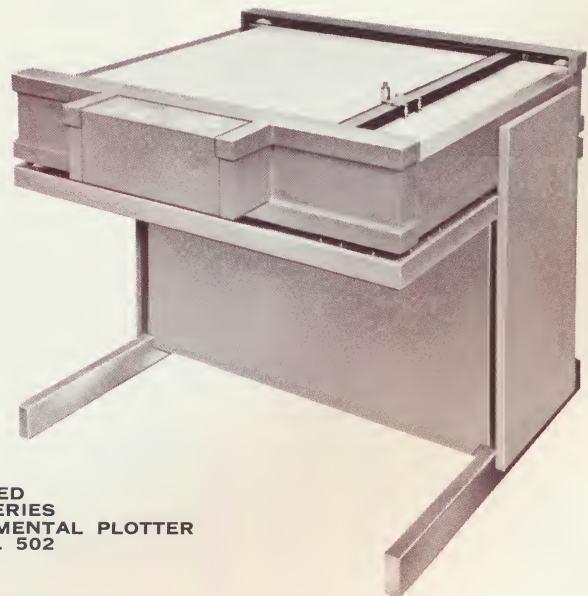
CalComp flatbed plotters are also available in two sizes: 31 by 34 inches, and 54 by 72 inches (plot area). The plot is produced by lateral motion of the beam and vertical motion of the pen carriage. Either ballpoint or liquid ink pens may be used. The flatbed plotter provides continuous display during plotting. It does not require special paper, and can handle a large variety of preprinted forms and special materials.



DRUM TYPE
700 SERIES
ZIP MODE®
MODEL 765



LARGE DRUM
500 SERIES
INCREMENTAL
PLOTTER
MODEL 563



FLATBED
500 SERIES
INCREMENTAL PLOTTER
MODEL 502

MAGNETIC TAPE SYSTEMS

FOR OFF-LINE DIGITAL PLOTTING

CalComp off-line digital plotting systems are compatible with any computer that writes standard IBM-format tapes at up to 800 bits-per-inch. Each magnetic tape unit is suitable for driving any of several models of CalComp digital plotters, both drum and flatbed types. CalComp 700 series tape units are also "convertible", so that a customer's system can be tailored to his present needs, and updated and expanded as those needs increase.

CALCOMP 470:

The compact CalComp Model 470 system provides a complete off-line digital plotting capability at minimum cost. The Model 470 is compatible with most standard digital computers, and is available with any standard CalComp digital plotter in the 500 series, both drum and flatbed types.

CALCOMP 750:

One of the four off-line systems in the 700 series, the 750 features high-speed bidirectional tape search and continuous tape address display. Operates with any CalComp 500 or 600 series plotter. Can be converted to Model 760, 770 or 780.

CALCOMP 760:

The Model 760 also operates with any CalComp 500 or 600 series plotter, and with the Model 835 Electronic plotter. Includes all features of the 750, plus a tape format that greatly reduces computer time for tape preparation. Easily converted to either Model 770 or 780.

CALCOMP 770:

This system includes all features of the 750 and 760 tape units, and adds the capability for driving the CalComp 700 series plotters for increased speed and greater precision. Also operates with 600 series and Model 835. Can be converted to Model 780 at any time.

CALCOMP 780:

The CalComp 780 is the senior member of the 700 series off-line digital plotting systems. Like the Model 770, this system is designed to drive the new 700 series Zip Mode® plotters, the 600 series and the Model 835. The Model 780 also adds a capability for reading higher density magnetic tapes.



MODEL 470
TAPE UNIT
WITH
500 SERIES
DRUM PLOTTER



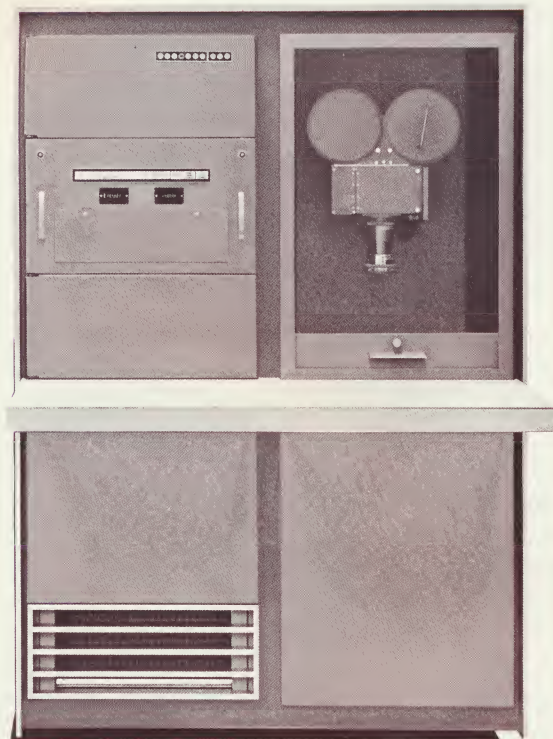
700 SERIES
TAPE UNIT
WITH
ZIP MODE®
DRUM PLOTTER

ELECTRONIC DIGITAL PLOTTER FOR HIGH VOLUME PLOTTING

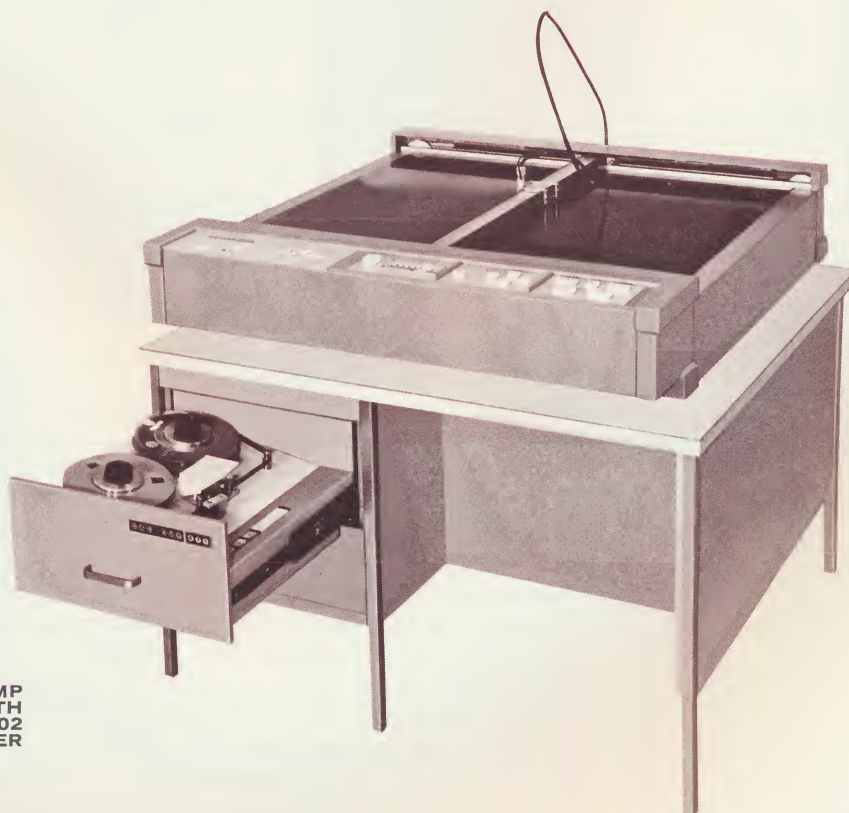
The CalComp Model 835 is a CRT/microfilm plotting system, precision engineered to provide ultra high-speed plotting and recording of any computer output data that can be converted to graphic form. Unlike whole-value CRT systems, the Model 835 is a true digital incremental plotter—utilizing the basic design principles and circuitry developed, perfected and patented by CalComp. When operated in an on-line system with a CalComp Plotter Controller, the Model 835 may be used in a time-shared configuration with other on-line equipment, and is capable of accepting input commands at rates up to 100,000 characters per second. When used in an off-line system with a CalComp Tape Unit (Model 760, 770 or 780), the Model 835 is capable of plotting all data on a complete 2400-foot reel of magnetic tape in 8 minutes. The standard model is supplied with a 35 mm microfilm camera. A 16 mm camera is offered as an option. An optional film viewer is also available with the system.

AUTOMATIC TRACER/DIGITIZER FOR CONVERTING GRAPHIC DATA TO DIGITAL FORM

The CalComp Model 471 Automatic Tracer/Digitizer provides automatic, precise, incremental tracing and recording, in computer tape format, of continuous-contour graphic data. The system uses any CalComp 500 series Digital Incremental Plotter, either drum or flatbed type, as the tracer mechanism, with the plotter pen assembly replaced by a photocell tracer head supplied with the Model 471. The magnetic tapes prepared on the Model 471 are in IBM (NRZI) format and are compatible with either character-oriented or word oriented computers. The system provides a fast, efficient, and accurate method for converting oscillograms or strip chart recordings to digital form for computer processing. Another major application is in the apparel industry where the Model 471 is used with a special computer program for automated size grading of garment patterns.



CALCOMP
MODEL 835



CALCOMP
MODEL 471 WITH
MODIFIED MODEL 502
FLATBED PLOTTER/TRACER

PLOTTER CONTROLLERS

FOR ON-LINE DIGITAL PLOTTING

The CalComp product line of digital plotting systems includes interface units for most standard digital computers, including the new time-shared systems. Current models available for the new time-shared computer systems include:

- Model 110 for IBM System/360
- Model 111 for Control Data 3000 series
- Model 112 for GE 400 and 600 series
- Model 113 for RCA Spectra 70

All models in this series are capable of driving any CalComp plotter. Modification of the computer circuitry is never required with CalComp on-line units. Plotter controllers of the Model 110 type include a number of special features for operator convenience and improved system efficiency. For detailed information about on-line plotting with *your* computer system, contact "CalComp Marketing."

REMOTE DIGITAL PLOTTING SYSTEMS

CalComp remote digital plotting systems are designed for automatic digital plotting of computer output data at remote locations. Remote plotter controllers or dataphone adapter units provide interface between any CalComp 500 series Digital Incremental Plotter and the standard Bell System DATA-PHONE Service.

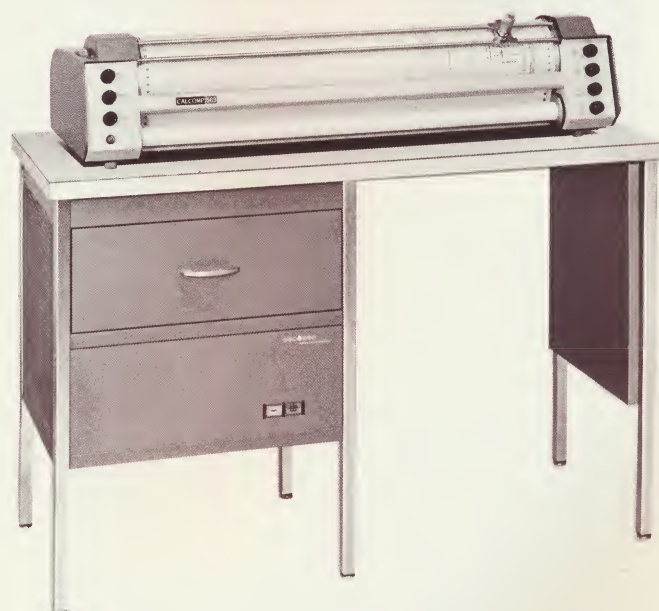
The new CalComp series of remote plotter controllers is intended for operation with time-shared computer systems and is compatible with standard teletypewriter equipment. This permits intermixed plotting and printing operations under remote programmed control. One central processing center can serve a large number of remote plotter stations, supplying separate data to each station or the same data to all stations. Each plotter/teletypewriter station can transmit instructions directly to the computer.

The CalComp series of dataphone adapters includes transmitter and receiver units, and a transceiver suitable for two-way data transmission. Provision is also made for closed-loop monitoring at the transmitting station using a local plotter for verification of transmitted data. The dataphone transmitter and transceiver units are compatible with CalComp off-line tape units and on-line plotter controllers.

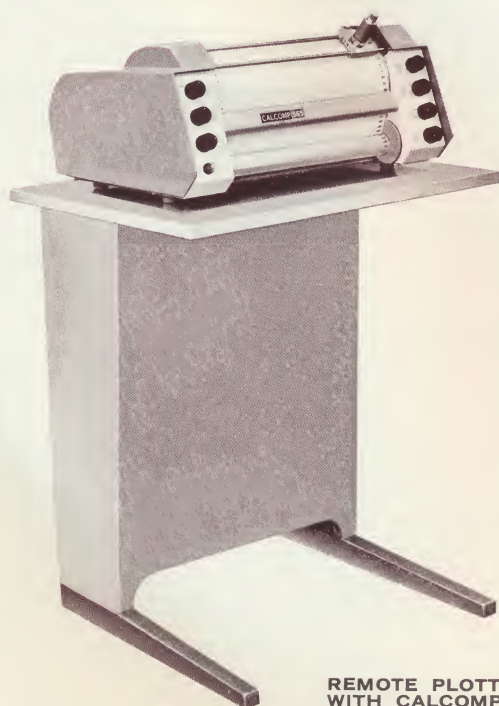
For more information about CalComp remote digital plotting systems, contact your local Sales Representative or CalComp Marketing.



**CALCOMP MODEL 110
PLOTTER CONTROLLER
FOR SYSTEM/360**



**DATAPHONE ADAPTER
TRANSCIVER WITH CALCOMP
MODEL 563 PLOTTER**



**REMOTE PLOTTER CONTROLLER
WITH CALCOMP MODEL 565 PLOTTER**

HOW DO YOU EVALUATE A DIGITAL PLOTTING SYSTEM?

By any yardstick, CalComp digital plotting systems represent the value standard against which others are measured. CalComp was first to design, develop, and patent a digital incremental plotter. CalComp was first to extend its applications into all branches of science, technology, business, and industry. Today, the complete line of CalComp digital plotters and plotting systems still ranks first in the industry. The reasons are summarized below.

PLOTTING QUALITY

How closely can the plotting system approach the quality of a drawing produced by a skilled draftsman? CalComp systems approach this standard more closely than any other equipment on the market. Our plotters produce inked drawings on quality paper which are readily reproducible and are suitable for display or binding without further processing.

ACCURACY AND REPEATABILITY

How accurate is the digital plotting system? Ideally, no information that the user is capable of reading from a graphic presentation should be lost in the digital plotting process. CalComp equipment can produce drawings with accuracy down to .005 inch, with excellent repeatability. All CalComp plotters can retrace a plot or curve many times without the slightest discernible deviation. Overprinted lines appear as one. In actual practice this means that an unlimited number of plots or graphs can be generated from the same computer program, with unvarying digital accuracy. No system using analog conversion can even approach this degree of accuracy.

PLOTTING FLEXIBILITY

What are the limitations of the digital plotting system? CalComp plotters can produce any variety of types and sizes of symbols, at any angle or position, in addition to their capability for producing any type of complex curve or line. In fact, the capabilities are limited only by programmer ingenuity. This flexibility is enhanced by the availability of different types and colors of pens and inks, and the wide variety of preprinted forms on continuous rolls.

PLOTTING SPEED

How fast can the system produce a graph or drawing, without sacrificing quality or accu-

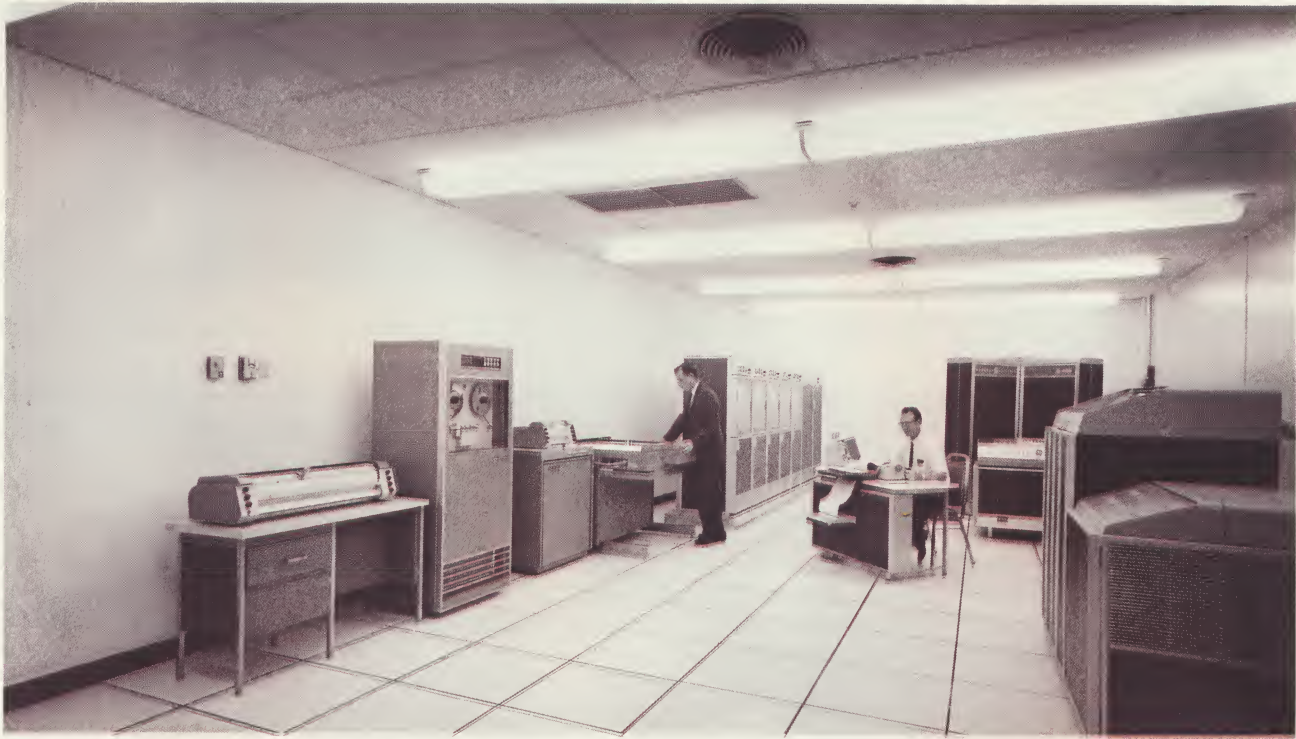
racy? CalComp Zip Mode plotters can move pen over paper at speeds up to 23.8 inches per second. They can produce a greater volume of complex, fully annotated graphic output in a given time than any other existing electromechanical system. For high-volume plotting requirements, CalComp now offers a cathode ray tube/microfilm digital plotting system capable of plotting up to 100,000 increments per second, the equivalent of 1000 inches per second.

COMPUTER TIME

How much computer time is required to produce a digital plot of given complexity and size? Computer time is costly, and should therefore be kept to the minimum consistent with accuracy and quality. For off-line plotting, the amount of magnetic tape required to produce a given plot is the determining factor. For on-line plotting, the maximum plotter speed and the size of the buffer storage available are of paramount importance. CalComp off-line systems can produce up to 29 linear inches of plot from a single inch of magnetic tape in the Zip Mode. CalComp on-line systems are capable of time-shared operation with other input/output equipment and, when equipped with optional core buffer storage, can accept input data at rates of several hundred thousand plot commands per second.

EQUIPMENT AVAILABILITY

All of the CalComp products described in this bulletin are standard equipment items, currently in production and available in quantity for off-the-shelf delivery. All items are fully warranted for six months, and delivery schedules are short—typically 30 to 45 days ARO. Demonstration equipment is available at the plant and CalComp's mobile demo vans are on continuous tour throughout the United States.



SIMPLICITY OF OPERATION

Is the system easy to operate? No special skills or technical training are required for operating a CalComp digital plotting system. The computer program makes all of the decisions. There are no critical adjustments, no operator intervention required during plotting.

EQUIPMENT FLEXIBILITY

Is there a digital plotting system that satisfies *your* particular requirements? No other manufacturer of digital plotting equipment offers the same range of digital plotter types, sizes, and capabilities. No other manufacturer offers the same wide choice of on-line or off-line system configurations, nor the provisions for expansion and upgrading to meet changing requirements.

EQUIPMENT RELIABILITY

How reliable is the system? CalComp equipment is designed and manufactured to exacting standards for maximum reliability with minimum maintenance. Hundreds of CalComp plotting systems in daily use over long periods of time have established a record of reliable

performance that is unmatched. Many have operated as long as *five years* with no servicing except cleaning and minor adjustment. References to satisfied users of CalComp equipment are available on request.

SOFTWARE

The quality and availability of software is a major factor in a digital plotting system, for expenditures in this area can easily exceed hardware cost. CalComp's programming staff and software library are second to none, and are devoted exclusively to the continual improvement of plotter software and to providing programming assistance to our customers.

PURCHASE OR LEASE

CalComp is dedicated to the objective of quality equipment and service at minimum cost in relation to performance achieved. We welcome the opportunity to prove that we can achieve this goal in your particular situation. CalComp equipment is available for outright purchase, or for lease with or without option to buy. Contact your local Sales Representative or "CalComp Marketing" for complete information.



SUPPORTING SERVICES

In the complex world of computers, the supporting services offered by a manufacturer are as important as the quality of the equipment itself. CalComp offers the most complete range of such services available from any manufacturer of digital plotting equipment.

SOFTWARE AND PROGRAMMING

The comprehensive software support provided by CalComp makes it possible for our customers to put their plotting system to work on the same day it is installed. CalComp maintains a staff of highly skilled programmers whose sole function is to provide software and programming assistance to customers. The years of plotting experience of this staff ensures that the software will be versatile, efficient, and complete. Our programming instructors conduct training classes for customer programmers and assist in solving specialized problems associated with plotting. CalComp software is written for use with FORTRAN, ALGOL, and COBOL compilers, and where necessary, is written in assembly language for optimum efficiency. Tested subroutines for most computers are available from our extensive software library. Our programming staff and our customers are constantly adding to this collection of routines. Simplicity of software design provides customer programmers full flexibility of plotter utilization with a bare minimum of training. The design specifications are identical for most computers, ensuring that little or no reprogramming is necessary in the event of upgrading a computer or plotting system.

FIELD SERVICE AND TRAINING

The excellent field service and training support provided by CalComp assures our customers of optimum efficiency and maximum performance from their digital plotting systems, with minimum downtime. CalComp field service personnel stationed at the plant establish maintenance procedures, provide consultation services, supervise the regional service centers, and conduct periodic in-plant training programs for our customers. Warranty service, including parts and labor, is provided free of charge during the first six months. Contract service is available for CalComp products anywhere in the continental United States.

DIGITAL PLOTTING ACCESSORIES

To assure our customers of maximum performance and flexibility of use, CalComp stocks an extensive line of digital plotting accessories. These include a wide range of plain and preprinted chart papers for the drum type digital plotters, and a complete line of pens for all plotters, including ball-points in assorted colors and liquid ink pens in several line widths. The liquid ink pens normally use standard drafting inks; however, special inks are recommended by CalComp for some applications. The accessory line also includes switching adapters for simultaneous or alternate operation of two or more digital plotters from a single tape unit or on-line interface unit, and plot display attachments for the 500 series drum type plotters. Tables in matching colors and styles are available for most plotter models. For detailed information on these and other accessory items, contact your local Sales Representative or "CalComp Marketing".



CALIFORNIA COMPUTER PRODUCTS, INC.

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